

IN THE SPECIFICATION:

Please replace paragraph [0007] with the following amended paragraph:

[0007] One issue encountered with progressive cavity pumps is degradation of the pump components at high temperatures. To operate effectively over a sustained period of time, the compliant seal between the rotor and housing must maintain its resiliency. The material used for effectively forming this seal, typically nitrile rubber, encounters temperature-based resiliency breakdown if the ambient to which the material is exposed exceeds approximately 250 degrees F. Thus, in fields with naturally occurring high downhole temperatures and in fields where steam injection is used to free heavy oil, such as tar sand, from the formation, the temperature of the oil will often exceed the 250 degree F. threshold, and rapid pump degradation will occur. Although other sealing materials have been used to form the rotor-to-pump seal, ~~[[they]]~~ there are compromises in terms of either performance or cost, and thus have received limited success in the marketplace.

[0021] Each production zone 18 includes casing 20, which lines the borehole 10 (typically lining the borehole over the entire length of the borehole 10) and which includes holes 24 extending therethrough at the production zone 18 which allow oil or other hydrocarbons from a production zone 18 in the earth adjacent the borehole 10 to flow into the borehole 10. The production zone 18 may be screened, i.e., a cylindrical screen may be located between the interior of the production zone 18 and the holes 24, to reduce the incidence of sand flowing therein from the formation, and may also be isolated from the remainder of the wellbore 10 by packers (not shown) placed above and below the production zone 18, which is well known in the art. As the fluid flowing into the well from the producing zone ~~[[22]]~~ 18 accumulates therein, it forms a pool of recoverable fluid in the well, which may be replenished as the fluids are removed from the production zone 18. However, the fluid in the production zone 18 exists at a pressure similar to that of the formation from which it is collected, which pressure is typically insufficient to naturally hydrostatically drive the oil to the well head location.

[0022] Within this production zone 18 is disposed a surface driven centrifugal pump 26, as best shown in section in FIG. 2. This pump 26 includes an outer housing 28, within which is formed a diffuser cavity 30 within which an impeller 32 is rotatably driven by a drive rod 34. Impeller 32 typically includes a plurality of vanes or blades 43 [[36]] which impart momentum/velocity to the fluid, when the impeller is rotated about its axis within the diffuser cavity 30. The interaction of the fluid with the diffuser cavity converts this velocity to pressure. As shown schematically in FIG. 1, pump 26 also includes fluid inlet 38 and an outlet 40 ported to tube [[54]] 50 for pumping of fluids up the well to the surface. A pump housing 28/impeller 32 combination, as described, typically cannot impart sufficient momentum to well fluids to cause them to be lifted to the earth's surface from a location deep in a borehole 10. Therefore, pump 26 typically includes a plurality of such pump housings 28 and impellers 32, the outlet 36 of each housing 28/impeller 32 combination passing into and forming the inlet 38 of the next housing 28/impeller 32 combination, until the momentum of the fluid leaving the last, uppermost pump housing is sufficient to propel the well fluid up the well to the well head 12. Preferably, the pump housings 28 are aligned such that the centerlines of each of impellers 32 are collinear, and the ~~lowestmost~~ lowermost housing 28 in the wellbore has the opening 38 opening for receiving well fluids therein, and the uppermost pump housing 28 has an outlet 40 for pumping the fluids to the well head 12. Furthermore, each pump housing 28 is configured to enable the interconnection of each impeller 32, such that all impellers 32 in the connected stack of impellers 32 are driven by a single drive rod 34 suspended from the earth's surface. Preferably, each impeller includes a central hub 41, having a plurality of blades 43 extending therefrom. Hub 41 includes a recessed female portion 45, into which, for the uppermost impeller 32, splines of the drive rod 34 may be received, and a splined male portion 57, which extends into the female portion 45 of the next below impeller 32, to enable common rotation of each impeller 32. Typically, pump 26 will include sufficient impeller 32/diffuser cavity 30 combinations, such that each combination in the stack, other than the lowermost housing which initiates receipt of the well fluids, and the uppermost housing 28 from which the well fluid is directed to the surface, supply the well fluid at an incrementally

higher pressure into the next adjacent impeller 32/diffuser cavity 30 combination, such that the well fluid leaves the uppermost housing 28 at a pressure sufficient to reach the surface. Typically, up to several hundred such housings 28 will be strung together to provide the pumping of the fluid from the wellbore 10.

[0025] During operation, main pump drive rod 34, although rotating at speeds at which, in the prior art, vibration whipping and/or whirling would occur which would cause failure by high speed interfering contact between the rod and the production tubing, operates successfully when encased in lubricant in a sleeve. Preferably, the rod 34 OD is on the order of 3/8" to 3/4" diameter (three eighths to three quarters of an inch diameter), leaving an annulus 60 space between the circumference of the rod 34 and the inner surface of the sleeve 54 nominally on the order of {fraction (1/16)}" (one sixteenth of an inch) within which the lubricant is maintained. In such configuration, a rod speed of greater than 3400 rpm can be maintained from a surface motor through the rod 34 and pump 26. The lubricant in the annulus, as bounded by the inner surface of the sleeve 54, prevents excursion of mass imbalanced portions of the drive rod 34, by absorbing energy where such conditions exist and forming a lubricated, damped physical barrier against significant physical movement of the rod 34 in a radial direction. Thus the drive rod 34 cannot achieve a high energy self-destructive state because it cannot deform into a significant arch, or whirling position, as was found in the prior art. Drive rod 34 as well as sleeve 54 may be configured as multiple sections of individual lengths to form the full length thereof.